TABLE 3.—*The probability that the differences found between the maximum and minimum rainfall for periods of 5 years might be due to chance*

No.	Locality	Part of record from which samples were taken		Mean annual precipitation during periods of—		P
		Maximum	Minimum	Maximum	Minimum	
				Inches	*Inches*	
4	Boise, Idaho	1869–73	1886–70	18.51	11.63	0.02
17	Key West, Fla	1851–55	1859–63	47.03	32.16	.01
19	Marietta, Ohio	1865–69	1891–95	47.15	34.63	.02
33	San Diego, Calif	1886–90	1896–1900	12.28	6.84	.02
34	San Francisco, Calif	1864–68	1897–1901	28.55	20.63	.04
35	Santa Fe, N.Mex	1874–78	1888–92	17.33	12.24	.01
40	Winnemucca, Nev	1883–87	1901–5	9.41	7.22	.04
41	Yuma, Ariz	1905–9	1899–1903	6.80	1.60	.01

While the records for these stations have significant 5-year maximum and minimum rainfall periods, the differences are not so great as found elsewhere.

The differences between the maximum and minimum rainfall for some stations were calculated by Bessel's formula. The mean annual precipitation for Boston from 1851 to 1880 was 51.95 ± 0.91 inches, while that for the minimum period from 1818 to 1847 was 41.07 ± 0.77 inches. The difference between these means is 10.89 ± 1.19 inches or about 25 percent of the recorded mean annual precipitation (41.02 to 1931) for Boston. This mean difference is statistically significant and shows that Boston had significantly more rainfall from 1851 to 1880 than during the earlier period. Another example will also illustrate this point. The mean annual precipitation for Charleston, S.C., from 1864 to 1886 was 56.81 ± 1.68 inches, while that for the period 1841 to 1863 was only 42.70 ± 1.13 inches. The difference between these means is 14.11 ± 1.34 inches and shows a significant difference between the maximum and minimum rainfall periods of Charleston. As significantly different maximum and minimum rainfall periods have occurred in the annual precipitation records of all these stations, it naturally follows that the average annual rainfall (precipitation) at these stations has changed from time to time.

Successive maxima and successive minima periods of rainfall for some of these stations have been compared. The annual precipitation record for Charleston, S.C., extends over two periods of minimum rainfall. The calculated cycle showed these minima to be at 1852½ and 1906. A comparison of the annual precipitation from 1848 to 1857 with that from 1902 to 1911 gave a probability value of 0.70. This indicated that the samples were alike and that one could expect to find similar differences due to chance only. Similar comparisons of the Lowell minima at 1840 and 1913, New Bedford maxima at 1828 and 1893, New Bedford minima at 1841 and 1913, New York City minima at 1838 and 1916, and Waltham minima at 1840 and 1920 gave probability values of 0.22, 0.69, 0.29, 0.25, and 0.81, respectively. All these values are well over 0.05 and indications are that these successive maxima are essentially equal and that these successive minima are also nearly equal.

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A COMPARISON OF DROUGHT CONDITIONS IN GEORGIA AND ARKANSAS

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[Weather Bureau office, Atlanta, Ga., Jan. 10, 1934]

A study of droughts in Georgia was recently completed following the methods applied by H. S. Cole in his article on Droughts in Arkansas, published in the MONTHLY WEATHER REVIEW for May 1933. It was desired to bring to light what the records show as to frequency of dry spells in Georgia and to compare such frequency with that in Arkansas as well as to examine such other drought conditions as might seem to be of interest.

Mr. Cole used the period of 1898–1930, inclusive, but in Georgia not many original records were found available for years prior to 1900. Therefore, it seemed best to use the period of 1900–1932 partly because the record of a station could be followed more easily in the original records than in the tables of daily precipitation published in monthly reports and partly because by beginning with 1900 it was possible to select 12 well-distributed stations having unbroken records through a 33-year period.

The inherent difficulties in defining drought in terms of rainfall are so generally realized and have been discussed by so many writers that it seems needless now to add to what has already been said on the subject. While no entirely satisfactory definition of drought has been formulated in terms of rainfall, still it is possible to make a valuable comparison of the drought conditions in one State with those of another by applying the same criteria and methods of analysis to the long-period records of a sufficient number of stations in each region.

The tables accompanying this paper present a summary of the results obtained in Arkansas and Georgia. The data for Arkansas have been taken from the published article by Mr. Cole cited above, while those for Georgia were derived by applying the same methods employed by Mr. Cole in his State. It is believed that this comparison may be regarded as a very satisfactory one, since 12 well-distributed stations were used in each State and the period covered by the records was of the same length and nearly identical as to the years included.

Mr. Cole says:

It was decided to use all 15-day periods without measurable rainfall during the warmer months, May to September, inclusive,

and to use 20-day periods without measurable precipitation during the remainder of the year. It was also decided that periods of over 15 days during the warmer months should be included if the rainfall for the additional days was at a rate less than 1 inch for each additional 15 days, and during the remainder of the year dry periods of over 20 days should be included if the precipitation for the additional days was at a rate less than 1 inch for each additional 30 days.

Under these restrictions Mr. Cole found for Arkansas a total of 844 droughts of various lengths from 15 to 126 days in the records of 12 stations within the 33-year period 1898–1930. This is slightly more than 2 droughts per year on the average at a given station, since the total amount of record compiled corresponds to 12 times 33, or 396 years for a single station. In Georgia the total number of droughts came out 770 for 12 stations during a period of 33 years, which is slightly less than 2 droughts per year on the average for a given station. This indicates a noticeable, though not important, difference between the two States, so far as mere frequency of droughts is concerned.

When the season of occurrence of the droughts is taken into consideration there is seen to be an important difference in favor of Georgia. Doubtless the droughts beginning in June, July, and August will in the long run result in more harm than those beginning in any other 3-month period. Georgia's droughts beginning in these months number only 191 as compared with 368 in Arkansas. This is seen to be quite significant when we consider how much less harmful the dry spells of other seasons generally are. A shortage of rainfall during the spring season, unless very acute, will be favorable for planting and cause little harm. Likewise a moderate shortage in the fall favors seeding operations and cotton harvesting.

Winter droughts in Georgia, as shown in table 1, are less frequent than those of any other season and are seldom of more than 30 days' duration.

While the total number of droughts is appreciably less in Georgia than in Arkansas, especially as to those that occur during the most important growing months, Georgia (see tables 2 and 3) has the larger number of the more prolonged droughts, especially of those that continue from 30 to 69 days. Out of 770 droughts in Georgia, 367, or nearly 48 percent, lasted 30 days or more, while Arkansas had 275 such droughts out of 844, or about 32 percent.

At individual stations in Georgia the total number of droughts within the stated 33 years ranged from 42 at Dahlonega in the northern section to 82 at Macon near the center of the State. The region of greatest drought frequency in Georgia is definitely indicated to be in the central and eastern counties northward about three fourths of the way over the State, with a rapid falling off beyond this area both to the west and north. As would naturally be expected, the region of least drought frequency is in the northern mountainous area where the normal rainfall is greatest.

In Arkansas the relative frequency appears to be greatest across the southern counties and least in the extreme northeast section, ranging from 93 at Arkansas City to 50 at Pocahontas. However, there is a somewhat surprising irregularity of distribution in the central part of the State. The total number of droughts found for Dardanelle somewhat northwest of the center of the State is 91, while the totals for the nearest surrounding stations used, beginning to the west and going clockwise around on the map are, respectively: Fort Smith, 66: Rogers, 63; Calico Rock, 75; Newport, 68; Little Rock, 58; and Mena, 65.

TABLE 1.—*Dry periods in 33 years, by months, for 12 stations in Georgia. Totals are shown for both Georgia and Arkansas*

Duration in days	January	February	March	April	May	June	July	August	September	October	November	December	Year
15 to 19	0	0	0	3	27	16	12	18	31	0	0	0	107
20 to 29	24	12	14	33	19	25	8	39	46	54	11	11	296
30 to 39	7	0	5	28	22	5	3	26	19	23	8	3	149
40 to 49	0	6	6	18	7	1	0	13	15	16	5	4	91
50 to 59	0	2	5	14	0	0	0	6	14	12	0	0	53
60 to 69	0	0	3	1	1	0	1	8	13	4	0	0	31
70 to 79	1	0	2	1	0	0	2	0	4	2	0	1	13
80 to 89	3	0	1	2	0	0	0	3	1	0	1	1	12
90 to 99	0	1	2	0	0	0	0	1	3	2	1	0	10
100 or more	0	0	0	0	1	0	0	4	1	2	0	0	8
Totals in Georgia	35	21	38	100	77	47	26	118	147	115	26	20	770
Totals in Arkansas	32	15	22	19	96	106	103	159	125	96	27	44	844

TABLE 2.—*Dry periods at 12 stations in Georgia in 33 years. Corresponding totals are shown for both Georgia and Arkansas*

Stations	15 to 19 days	20 to 29 days	30 to 39 days	40 to 49 days	50 to 59 days	60 to 69 days	70 to 79 days	80 to 89 days	90 to 99 days	100 or more days	Greatest number of days in any drought	Precipitation in the longest drought
Albany	9	22	12	5	1	4	2	0	1	1	104	2.83
Athens	15	26	13	7	3	0	0	0	0	1	134	2.97
Columbus	4	18	16	8	2	6	0	1	0	1	104	2.86
Dahlonega	9	19	5	4	2	2	1	0	0	0	71	.50
Dublin	9	29	14	7	5	0	0	1	4	1	103	2.07
Macon	5	26	12	18	9	4	4	2	2	0	99	2.38
Newnan	13	24	16	7	5	2	0	1	0	0	87	1.27
Rome	8	22	8	8	6	1	0	1	0	0	86	2.62
Savannah	6	26	12	7	8	3	2	3	3	3	135	3.24
Thomasville	6	18	10	8	4	4	2	0	0	0	78	.51
Washington	14	33	20	3	2	2	1	1	0	0	80	1.85
Waycross	9	33	11	9	6	3	1	2	0	1	144	2.59
Totals in Georgia	107	296	149	91	53	31	13	12	10	8	------	------
Totals in Arkansas	204	365	121	52	39	16	20	12	5	10	------	------

TABLE 3.—*Number of dry periods in Georgia (12 stations during 33 years) with 15 days or more, 20 days or more, etc. Corresponding totals are shown for both Georgia and Arkansas*

Stations	15 days or more	20 days or more	30 days or more	40 days or more	50 days or more	60 days or more	70 days or more	80 days or more	90 days or more	100 days or more
Albany	57	48	26	14	9	8	4	2	2	1
Athens	65	50	24	11	4	1	1	1	1	1
Columbus	56	52	34	18	10	8	2	2	1	1
Dahlonega	42	33	14	9	5	3	1	0	0	0
Dublin	70	61	32	18	11	6	6	6	5	1
Macon	82	77	51	39	21	12	8	4	2	0
Newnan	68	55	31	15	8	3	1	1	0	0
Rome	54	46	24	16	8	2	1	1	0	0
Savannah	73	67	41	29	22	14	11	9	6	3
Thomasville	52	46	28	18	10	6	2	0	0	0
Washington	76	62	29	9	6	4	2	1	0	0
Waycross	75	66	33	22	13	7	4	3	1	1
Totals in Georgia	770	663	367	218	127	74	43	30	18	8
Totals in Arkansas	844	640	275	154	102	63	47	27	15	10